Tune-ups

Procedures and Maintenance Items

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1 General Tune-up Procedures

An automotive tune-up is a job that has changed significantly over the years. Although the term is now somewhat archaic, it is still widely used by many drivers to describe a service procedure intended to make an engine run better. There's no universal definition of exactly what items a tune-up should include, but most would agree that it involves replacing the vehicle's spark plugs and performing other adjustments in order to maintain or restore peak engine performance, although, there isn't much under the hood that can be adjusted on many late model vehicles.

Ignition timing is fixed and controlled by the engine computer nowadays, as are idle speed and air/fuel mixture. Although it is possible to check the vehicle's base timing, idle speed, and various emission functions to ensure they are all within factory specifications, there is really very little, if anything, left to "tune." However, most drivers still think about a tune-up when a problem arises.

The vehicle may be hard starting, feeling down on power, stalling, hesitating, returning poor mileage, knocking, or it may have failed an emissions test. A simple maintenance type tune-up (a new set of plugs) may make the engine easier to start, improve fuel economy, lower emissions, restore lost power, etc, provided the engine's performance deteriorated because of worn or fouled plugs. If the problem lies elsewhere, a new set of plugs alone won't do the trick.

A proper modern tune-up must begin with a series of diagnostic tests to determine which, if any, components require replacement. A few "maintenance item" components should always be replaced for preventative maintenance purposes.

1.1 Diagnostic Checks

Any tune-up today should start with a number of performance checks to baseline or confirm the engine's overall condition. These include:

- **Charging system and battery voltage tests** (very important because of all of today's onboard electronics)
- **A fault code scan** to verify the absence of diagnostic trouble codes, and to retrieve codes that may be present for diagnosis and correction
- **Idle speed verification** to detect possible ISC motor problems
- **Idle mixture (older carbureted engines) or injector dwell (newer engines)** to confirm proper feedback fuel control
- **Ignition timing verification** to detect possible computer or sensor problems, even if not adjustable
- **EGR system check** to confirm proper operation
- **Engine vacuum tests** to detect both air leaks and exhaust restrictions

- **Fuel feedback control loop tests** to confirm that the system enters closed loop operation when the engine warms up

- **Power balance or dynamic compression tests** to identify any mechanical problems such as leaky exhaust valves, worn rings, bad head gasket, bad cam, etc. that could adversely affect compression and engine performance

- **Exhaust emissions tests** to confirm the vehicle's ability to meet applicable clean air standards, and to detect gross fuel, ignition, or emission problems that require attention

In addition to the above tests, all hoses and belts should be visually inspected for tightness physical integrity. All fluids (oil, coolant, transmission fluid, power steering fluid and brake fluid) should also be checked to ensure the proper level and acceptable condition of each fluid. The engine oil should contain no sludge; the ATF should not smell like burnt toast; the coolant should contain the proper concentration of antifreeze and be free of rust and sediment; and the brake fluid should be clear and uncontaminated.

1.2 Preventative Maintenance Replacement Components

The following items should be replaced at their recommended intervals for preventative maintenance reasons:

- Spark plugs, properly gapped to the manufacturer’s specification
- Rotor and/or distributor cap, if required
- Fuel filter; Air filter; PCV valve and breather filter
- Other parts, such as plug wires, belts, hoses, and fluids, on an "as required" basis
- O2 sensors.

1.2.1 Spark Plugs

The recommended replacement interval for standard spark plugs is typically every 30,000 to 45,000 miles. Most of today’s extended life plugs are constructed with special wear-resistant electrodes made of exotic alloys that minimize electrode erosion. Such plugs will usually last 100,000+ miles with little or no electrode wear. However, they can still become fouled if an engine has an oil consumption problem or spends considerable time idling, so they may require replacement before the electrodes have significantly worn.

Plugs on engines equipped with aluminum cylinder heads should be changed only after the engine has cooled in order to minimize the risk of damaging the aluminum threads. Some spark plugs produced specifically for aluminum head applications are constructed with precoated threads to reduce the risk damage, so applying anti-seize compound to the plug threads prior to installation may be unnecessary. If you do apply anti-seize,

remember that it acts as a lubricant and reduce the tightening torque on the plugs by 40%. Applying maximum recommended torque to lubricated plugs might damage the threads in the heads.

The safe torque range for the plug is determined by its size and seat type, as well as the head material. Spark plugs with gasket style or crush ring seats require more torque than those with taper seats. Always follow the vehicle manufacturer's torque recommendations, but as a rule of thumb, the following DRY PLUG guidelines may be used:

- 14mm plugs with gasket style seats should be tightened to between 26 and 30 lbs-ft in cast iron heads, or between 18 and 22 lbs-ft in aluminum heads.
- 18 mm plugs with gasket style seats should be tightened to between 32 and 38 lbs-ft in cast iron heads or between 28 and 34 lbs-ft in aluminum heads.
- 14mm taper seat spark plugs should be tightened to between 7 and 15 lbs-ft in either cast iron or aluminum heads
- 18mm taper seat plugs should be tightened to between 15 and 20 lbs-ft in either cast iron or aluminum heads.

Always follow the manufacturer's recommendations with regard to plug gap, unless you are installing a set of Bosch's new Platinum+4 spark plugs, which are pre-gapped at the factory to a standard 1.6 mm gap to achieve maximum plug performance and longevity and should not be regapped.

Inspect the condition of the spark plug cables and boots when changing plugs. Loose fitting boots or damaged cables can cause ignition misfire. Also, ensure the cables are properly routed and supported in looms to avoid crossfire problems and contact with the hot exhaust manifold.

1.2.2 Oxygen Sensors

Deterioration of O2 sensors can be caused by a variety of substances that find their way into the exhaust (such as lead, silicone, sulfur, even oil ash) as well as environmental factors such as water, splash from road salt, oil and dirt.

If an O2 sensor circuit opens, shorts or drifts out of range, it will usually set a fault code and illuminate the Check Engine or Malfunction Indicator Lamp. However, an O2 sensor that is badly degraded may continue to function well enough to avoid a trouble code but not well enough to prevent an increase in emissions and fuel consumption. In other words, the absence of a fault code or warning lamp doesn't guarantee that an O2 sensor is doing its job. Always use an OBDII Scan tool to verify O2 sensor performance.

A sluggish oxygen sensor may prevent the computer from toggling the fuel mixture rich/lean fast enough to keep emissions within acceptable limits, and a dead sensor will cause the system to remain in open loop mode, with a fixed, rich fuel mixture. Fuel consumption and emissions will increase, and the converter may suffer damage from overheating. Sluggish O2 sensors are also behind many drivability problems.

A recent EPA study found that 70% of all vehicles that failed emissions tests needed new O2 sensors. To avoid such issues, the O2 sensor should be replaced for preventative maintenance reasons during a tune-up. Replace unheated 1 or 2 wire O2 sensors on 1976 through early 1990s applications every 30,000 to 50,000 miles. Heated 3 and 4-wire O2 sensors on mid-1980s through mid-1990s applications should be replaced every 60,000 miles. On OBDII equipped vehicles (all '96 and newer), the recommended replacement interval is every 100,000 miles.

1.3 Additional Tune-up Procedures

On older vehicles, adjustment of ignition timing, idle speed and idle mixture should be performed only after completing all component replacements.

Cleaning the **fuel injectors** and **intake system** should be part of any contemporary tune-up. Injector cleaning isn't as critical as it once was, thanks to improved fuel additives and redesigned injectors, but injector clogging is back on the rise in areas using reformulated gasoline.

Fuel varnish deposits form in injectors and restrict the amount of fuel that's delivered with each pulse. This leans out the air/fuel mixture, which can result in lean misfire and a general deterioration in engine performance and responsiveness. Deposits can also build up on the backs of intake valves, causing cold hesitation problems in many engines. To avoid these problems, clean the injectors and valves. Cleaning is recommended for any engine suffering from performance issues and any engine that has more than 50,000 miles on the odometer. Additionally, cleaning the throttle body may also help eliminate idle and stalling problems that plague many of today's engines.

1.4 Other Preventive Maintenance Items

Newer vehicles don't require as much maintenance as older ones because adjustments such as timing, idle speed and mixture, etc. have been eliminated. The need for chassis lubrication has also been eliminated, thanks to sealed ball joints and tie rod ends, and many OEM parts are also built to much higher durability standards. However, some items still require periodic preventative maintenance replacement.

1.4.1 3,000-mile/3-month Items

Regular **oil and filter** changes are still necessary to maintain proper engine lubrication. Most experts still recommend changing the oil and filter every 3,000 miles or three to six months. The recommended oil change interval should be extended ONLY if a vehicle is driven under ideal conditions, i.e. no extremely hot or cold weather, no short trip, stop-and-go driving, no excessive idling, no dusty road conditions, no trailer towing, no turbocharging. Obviously, very few vehicles qualify for extended oil change intervals.

1.4.2 6,000-mile/6-month Items

Air filter service life depends more on environmental factors than time or mileage. If a vehicle is driven on dusty or gravel roads, filter life may only be a few months or few

thousand miles. Air filters on vehicles driven only in ideal conditions may last 12,000 miles.

1.4.3 12,000-mile/12-month Items

For reliable engine operation and fuel system performance, a clean fuel supply is absolutely essential. The **fuel filter** is the fuel system's primary line of defense against dirt, debris and small particles of rust that flake off the inside of the fuel tank. If not trapped by the filter, such contaminants can plug fuel-metering orifices in a carburetor or prevent valves from seating. In fuel-injected engines, fuel debris can clog injector inlet screens and starve the injector for fuel. Furthermore, if debris gets inside the injector, it can wear or jam the pintle valve and seat. Vehicle manufacturers typically recommend fuel filter replacement every 30,000 miles, but many professional mechanics recommend changing the fuel filter annually is a good way to prevent fuel-related problems.

1.4.4 20,000-mile/2-year Items

It's unlikely that a set of front **disc brake pads** will last more than 20,000 to 30,000 miles. The same goes for **belts** and **hoses**. The **transmission fluid** should also be changed at 20,000 – 30,000-mile intervals.

Brake fluid is hygroscopic and absorbs moisture over time. After two or more years of service, it can become badly contaminated with moisture. This lowers its boiling point up to 25% (which may contribute to pedal fade if the brakes overheat). It also promotes internal rust and corrosion that can damage calipers, wheel cylinders and antilock brake system components. Although vehicle manufacturers have no requirements with respect to changing brake fluid, many brake experts recommend changing the fluid every two years to prolong the life of the hydraulic components in the brake system and improve safety.

1.4.5 30,000-mile/3-year Items

Most vehicle manufacturers recommend changing the **engine coolant** every two to three years or 30,000 miles to replenish the corrosion inhibitors. If the cooling system is dirty, use a flush to remove rust and scale.

If the vehicle is equipped with a **cabin air filter** that cleans air entering the passenger compartment, the filter should usually be replaced every 30,000 miles or as recommended by the vehicle manufacturer.

1.4.6 As-required Items

Many components have no periodic recommended replacement intervals. The **battery, water pump, power steering pump, exhaust system components, etc.** must be replaced as necessary.

Additionally, there is no recommended **power steering fluid** replacement interval for preventive maintenance, but the fluid should be replaced whenever the pump or steering gear has failed and is being replaced. It's also important to check the fluid level in the

pump reservoir periodically. A low fluid level usually indicates a leaky hose or seal somewhere in the system.